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Pipes and fittings of acrylonitrile/butadiene/styrene terpolymer (ABS) — Chemical resistance with respect to fluids

Tubes et raccords en terpolymère acrylonitrile/butadiène/styrène (ABS) — Résistance chimique vis-à-vis des fluides

Technical Report 6285 was drawn up by Technical Committee ISO/TC 138, *Plastics pipes, fittings and values for the transport of fluids*, and approved by the majority of its members. The reason which led to the decision to publish this document in the form of a Technical Report rather than an International Standard is that the document represents a guide to the present technical knowledge relating to the chemical resistance of ABS.

0 Introduction

The chemical resistance values in this Technical Report are based on acrylonitrile/butadiene/styrene terpolymer (ABS) chemical resistance tables prepared within several member countries participating in the work of TC 138.

This Technical Report lists the chemicals as either suitable, unsuitable or as of limited suitability for their conveyance at the stated temperature with ABS pipes and fittings when these are not subjected to pressure.

ABS formulations may differ not only by combining different quantities of the three principal monomers (acrylonitrile, butadiene and styrene) but also by the means used to combine the individual monomers to produce the terpolymers, and such variations will be somewhat reflected in the chemical resistant properties of individual formulations.

The table gives an initial classification of the chemical resistance of pipes and fittings made of ABS which is not based on any specific formulation of ABS, but which is applicable to pipes and fittings made from ABS material covered by ISO 2580.

In general, the chemical resistance table in this document is based on industrial practice and experience gained over the last two decades in the field of application within the chemical industry.

1 Scope and field of application

This Technical Report represents the present technical knowledge relating to the chemical resistance of ABS and will serve only as a preliminary guide for the end user. The evaluation of chemical resistance listed in this Technical Report is based on practical experience and test results obtained through scientific investigation.

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Descriptors : piping, pipe tubes, pipe fittings, plastic tubes, acrylonitrile/butadiene/styrene (ABS), chemical resistance, fluids.

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These tests[1] are immersion tests at the stated temperature and normal atmospheric pressure by which the effects of the chemicals are evaluated by changes in tensile strength, elongation at break and mass.

The results give a general indication as to the suitability of ABS pipes systems for the transport of chemical fluids, but are not a specific guarantee in relation to any specific formulations.

The data are applicable to pipes and fittings at the listed temperatures and not subjected to applied stress due to internal pressure of external forces such as soil loading.

2 References

ISO 527, *Plastics — Determination of tensile properties.*[2]

ISO 2580, *Plastics — Acrylonitrile/butadiene/styrene (ABS) moulding and extrusion materials.*

ISO 7245, *Pipes and fittings of acrylonitrile/butadiene/styrene (ABS) — Designation.*[3]

3 Symbols and abbreviations

The criteria for classification, symbols and abbreviations adopted in this Technical Report are as follows :

S = Satisfactory

The chemical resistance of an ABS pipe or fitting exposed to the action of a fluid is classified as "satisfactory" when the results of tests are acknowledged to be "satisfactory" by the majority of the countries participating in the evaluation.

L = Limited

The chemical resistance of an ABS pipe or fitting exposed to the action of a fluid is classified as "limited" when the results of tests are acknowledged to be "limited" by the majority of the countries participating in the evaluation.

Also classified as "limited" are the resistances to the action of chemical fluids for which judgements "S" and "NS" or "S" and "L" are pronounced to an equal extent.

In the case of certain chemicals in the mid-range of aggressive attack on ABS, the classification of "limited" has been adopted due to the varying resistance of different specific formulations of ABS, prepared for different end users.

NS = Not Satisfactory

The chemical resistance of an ABS pipe or fitting exposed to the action of a fluid is classified as "not satisfactory" when the results of tests are acknowledged to be "not satisfactory" by the majority of the countries participating in the evaluation.

Also classified as "not satisfactory" are the resistances to the action of chemical fluids for which judgements "L" and "NS" are pronounced to an equal extent.

NOTE — Solution concentrations given in the table are expressed as a percentage by mass (unless otherwise stated). Where no concentration is given, the chemical is tested in its natural state, or in a saturated aqueous solution (Sat. sol.), or in a solution at its normal maximum working concentration (Conc.).

In the table, the resistance data (S, L, NS) are reported on the right side of each fluid, but the same data are to be considered pertaining to the ABS pipes or fittings, not to the fluid.

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1) Where testing has been carried out on a laboratory basis the criteria for evaluation have been as follows :

The specimens for immersion testing in any given media at any given temperature, would be prepared by injection moulding or stamping from suitable pipe to the requirements of ISO 527, type B (hitherto type 1 of ISO/R 527).

The tests should be carried out at the specified temperature within a tolerance of ± 10 °C for such a period that the exposed specimens would reach constant mass in the test media prior to mechanical evaluation. The strain of such testing would be 50 mm/min.

This Technical Report gives specifications related to the basic formulations recommended for pipes and fittings in ISO 7245.

2) At present at the stage of draft. (Revision of ISO/R 527.)

3) At present at the stage of draft.

Table — Chemical resistance of ABS pipes and fittings

Chemical	Concentration % (*m*/*m*)	Chemical resistance at 20 °C	Chemical resistance at 50 °C
(A)			
Acetamide	5	S	S
Acetic acid	5	S	S
Acetic acid***	50	NS	NS
Acetic acid	Glacial	NS	NS
Acetic anhydride		NS	NS
Acetone		NS	NS
Acid [see the name of the acid]			
Acetophenone		NS	NS
Acetyl chloride		NS	—
Alcohol [see the name of the alcohol]			
Acrylonitrile		NS	—
Allyl alcohol		NS	NS
Aluminium chloride		S	S
Aluminium sulphate		S	S
Ammonium carbonate		S	S
Ammonium hydroxide		S	S
Ammonium molybdate		S	S
Ammonium nitrate		S	S
Ammonium sulphate		S	S
Ammonium thiocyanate		S	S
Amyl acetate		NS	NS
n-Amyl alcohol***		NS	NS
Aniline		NS	NS
Aqua regia		NS	NS
(B)			
Barium bromide		S	S
Barium carbonate		S	S
Barium chloride		S	S
Benzene		NS	NS
Benzaldehyde		NS	NS
Benzoic acid		S	S
Benzoyl chloride		NS	NS
Benzyl alcohol		NS	NS
Benzyl chloride		NS	NS
Bromoethane		NS	NS
Butanone		NS	NS
2-Butoxyethanol		S	—
Butyl acetate		NS	NS
Butyl alcohol		NS	NS
Butyric acid (Butanoic acid)		NS	NS
Butyryl chloride		NS	—
(C)			
Calcium bromide		S	S
Calcium chloride		S	S
Calcium hypochlorite		S	S
Carbon dioxide (gas) dry		S	S
Carbon disulphide		NS	NS

Table — Chemical resistance of ABS pipes and fittings *(continued)*

Chemical	Concentration % (*m*/*m*)	Chemical resistance at 20 °C	Chemical resistance at 50 °C
Carbon tetrachloride		NS	NS
o-Chlorobenzene		NS	NS
Cetyl alcohol		S	—
Chlorine, dry and wet		NS	NS
Chloroform		NS	NS
Chloropropane		NS	NS
Chromic acid***	10 %	L	NS
Chromic acid	30 %	NS	NS
Citric acid	10 %	S	—
Citric acid	25	S	S
Cod liver oil		S	S
Copper(II) chloride		S	—
Copper(II) sulphate		S	S
Corn oil		S	—
Cotton seed oil		S	S
m-Cresol		NS	—
Cyclohexane		S	L
Cyclohexanol		S	L
Cyclohexanone		NS	NS
Cyclohexylamine		NS	—
(D)			
Dibutylphthalate		—	NS
Dichlorobenzene		NS	NS
Dichloroethane		NS	NS
Diethanolamine		S	S
Diethylamine		NS	—
Diethylether		NS	NS
Diethylene glycol		S	S
Dimethylformamide		NS	NS
Diphenylamine		S	S
(E)			
Ethanol	40	NS	NS
Ethanol	95	NS	NS
2-Ethoxyethanol		—	NS
Ethyl acetate		NS	NS
Ethylene glycol		S	S
(F)			
Fluorosilicic acid	25	—	NS
Formaldehyde	30	S	S
Formic acid	40	S	S
Furfuryl alcohol		NS	NS
(G)			
Gasoline(aliphatic hydrocarbons) (super)		NS	NS
Glucose		—	S
Glycerine		S	S

Table — Chemical resistance of ABS pipes and fittings (*continued*)

Chemical	Concentration % (*m*/*m*)	Chemical resistance at 20 °C	Chemical resistance at 50 °C
(H)			
Heptane		S	—
n-Hexane		NS	NS
Hydrochloric acid***	20	L	L
Hydrochloric acid	36	L	NS
Hydrochloric acid (gas wet)		NS	NS
Hydrofluoric acid	10	S	NS
Hydrofluoric acid	50	NS	NS
Hydrogen peroxide***	10 vol.	L	L
(I)			
Iodine***	Sat. sol.	L	NS
Iron(II) chloride		S	S
Iron(II) sulphate		S	S
Iron(III) chloride		S	S
Iron(III) nitrate		S	S
Isobutyl alcohol***		L	NS
Isobutyronitrile		NS	—
Iso-octane		S	—
Isopropyl acetate		NS	—
Isopropyl alcohol		S	—
(L)			
Linseed oil (raw)		S	NS
(M)			
Magnesium carbonate		S	S
Magnesium chloride		S	S
Magnesium sulphate		S	S
Mesityl oxide		NS	NS
Methanol		NS	NS
2-Methoxy ethanol***		L	NS
Methyl acetate		NS	NS
Methyl butyl ketone		NS	NS
Methyl cyclohexanone		S	S
Methyl ethyl ketone		NS	NS
(N)			
Nitric acid***	5	S	NS
Nitric acid	20	L	NS
Nitric acid	Conc.	NS	NS
Nitrobenzene		NS	NS
(O)			
Oleic acid		S	L
Olive oil		S	—

Table — Chemical resistance of ABS pipes and fittings (*continued*)

Chemical	Concentration % (*m*/*m*)	Chemical resistance at 20 °C	Chemical resistance at 50 °C
(P)			
Paraffin		S	—
Pentane		NS	NS
Perchloroethylene		NS	—
Phenol	5	NS	—
Phthalic acid	Sat. sol.	S	S
(S)			
Sodium bromide		S	S
Sodium carbonate	25	S	S
Sodium chloride	Sat. sol.	S	S
Sodium chromate		S	S
Sodium fluoride		S	S
Sodium hydrogen carbonate		S	S
Sodium hydrogen sulphate		S	S
Sodium hydroxide	25	S	S
Sodium hypochlorite		S	S
Sodium nitrate		S	S
Sodium perborate		S	S
Sodium phosphate		S	S
Sodium sulphate	0,1	S	S
Sulphur dioxide	Moist	NS	—
Sulphuric acid	15	S	S
Sulphuric acid	50	S	L
Sulphuric acid	Conc.	NS	NS
(T)			
Tin(II) chloride		S	S
Toluene		NS	—
Trichlorobenzene		NS	—
Trichloroethylene		NS	—
Triethanolamine		S	S
Triethylene glycol		S	—
Trisodium phosphate		S	—
Turpentine		NS	NS
(U)			
Uric acid		S	—
(X)			
Xylene		NS	NS
(Z)			
Zinc chloride	58	S	S
Zinc stearate		S	S

Table — Chemical resistance of ABS pipes and fittings (*concluded*)

Chemical	Concentration % (*m*/*m*)	Chemical resistance at 20 °C	Chemical resistance at 50 °C
Miscellaneous			
Beer	3,2 % (*V*/*V*) of alcohol	S	S
Crude oil		L	L
Detergent soap, aqueous solution	1	S	—
Ginger ale		S	—
Grapefruit juice		S	S
Honey		S	S
Horseradish		S	—
Kerosene		S	—
Margarine		S	S
Mayonnaise		S	—
Milk		S	S
Mustard, aqueous		S	—
Solvent, naptha		NS	NS
Water, distilled		S	S
Water, fresh		S	S
Water, sea		S	S
Wine		S	S

*** These chemicals are asterisked to draw attention to a disagreement in chemical classification between member countries. This disagreement is thought to be the result of the effect of one chemical on varying formulations.